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Request for grant of a patent

See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

Your reference	DCS/P02126UK
Patent application number *(The Patent Office will fill in this part)*	24 DEC 2003 0329980.7
Full name, address and postcode of the or of each applicant *(underline all surnames)*	Surface Generation Limited 8 Orton Enterprise Centre Bakewell Road, Orton Southgate Peterborough, PE2 6XU
Patents ADP number *(if you know it)*	8779183001
If the applicant is a corporate body, give the country/state of its incorporation	England
Title of the invention	Improved Tooling System
Name of your agent *(if you have one)*	**Marks & Clerk**
"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	**144 New Walk** **Leicester** **LE1 7JA**
Patents ADP number *(if you know it)*	8691164001 ~~711002~~

If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

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Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'yes' if:*

a) any applicant named in part 3 is not an inventor, or

b) there is an inventor who is not named as an applicant, or

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yes

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Continuation sheets of this form	
Description	6
Claim(s)	3
Abstract	
Drawing(s)	3 + 3 RM

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translation of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	1
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature: Marhoe Clerk — Date: 23.12.03

12. Name and daytime telephone number of person to contact in the United Kingdom: Diana C Stagg (0116) 233 8181

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Title: Improved Tooling System

The present invention relates to an improved component for use in a tooling system, and to an improved tooling system including this component.

The improved component is particularly suitable for use in the tooling systems described and claimed in International Patent Application No. WO 02/064308.

International Patent Application No. WO 02/064308 describes and claims a tooling system comprising a plurality of elements arranged in an array, each element being moveable longitudinally relative to the other elements in the array and having a first end, the system further comprising means to adjust the relative longitudinal positions of the elements such that the free ends of the elements define approximately a desired surface contour and means for retaining the elements in their adjusted positions, characterised in that: the first end of each element is provided on a machinable portion removably mounted to a base portion, the arrangement being such that the free ends of the elements can be machined to produce the desired surface contour.

International Patent Application No. WO 02/064308 further describes and claims a tooling system comprising a plurality of elements arranged in an array, the elements of the array being movable between a closed position in which the elements contact one another and are secured in position, and an open position in which the elements of the array are spaced apart and are capable of vertical movement relative to one another, and drive means for opening and closing the array. The elements are mounted on support rails to form the array.

It is an object of the present invention to provide a device for retaining the elements of an array of this type relative to one another, in order to provide an improved surface contour.

The present invention provides a tooling system which comprises a plurality of elements arranged in an array, the elements of the array being movable between a closed position in which the elements contact one another and are secured in position, and an open position in which the

elements of the array are spaced apart and are capable of vertical movement relative to one another, characterised in that the tooling system further comprises bolster means provided to align the elements during closing of the array and to hold the elements of the array securely in the closed and aligned position.

In a preferred embodiment of the tooling system according to the invention, the bolster means has an element contacting face which is adapted selectively to apply localised pressure to one or more elements of the array.

The pressure may for example be applied mechanically, hydraulically or pneumatically.

The elements of the array are preferably substantially polygonal, for example triangular, rectangular or pentagonal, in cross-section and are preferably arranged so that, in the closed position of the array, the major axes of adjacent elements are aligned and their vertices touch one another, so that the elements of the array tessellate.

In a preferred embodiment of the tooling system according to the invention, the array is substantially rectangular in plan view and bolster means are provided on the four sides of the rectangle, the bolster means on at least two adjacent sides of the rectangular array having element contacting faces which are adapted selectively to apply localised pressure to one or more elements of the array.

In a particularly preferred embodiment of the tooling system according to the invention, the array is substantially rectangular in plan view and bolster means having element contacting faces which are adapted selectively to apply localised pressure to one or more elements of the array are provided on all four sides of the rectangular array.

In such an arrangement, the outer edges of the rectangular array are serrated and the bolster means preferably has a correspondingly serrated face. In a preferred embodiment of the tooling system according to the invention, the face of the bolster means contacting the array is formed from a plurality of teeth, at least some of which teeth are adjustable in order selectively to apply localised

pressure to one or more elements of the array, in line with the sides of the elements. The teeth are preferably also individually adjustable in height relative to one another.

The element contacting face is preferably formed with a smooth face, so that there is low friction between the element contacting face and the element, when pressure is applied parallel to the sides of the elements, to allow pressure from the perpendicular bolster teeth to align elements in that direction also.

Each side of the bolster means may be formed of two or more separate component sections, so that one or more component sections may be moved to allow opening and adjustment of a part of the array, while maintaining the remainder of the array secured in the closed position.

In a preferred embodiment of the tooling system according to the invention, the bolster means may comprise two sets of bolsters, the first of which is used during machining of the elements of the tooling system and the second of which is used when the elements of the array have been machined and the system is being used as a mould. The use of two sets of bolsters provides advantages in both cost and weight saving, as the second set of bolsters is both simpler and lighter in weight than the first set.

The tooling system preferably further comprises means for securing the second set of bolster means in position around the array of elements, for example a pallet strap, which may be carbon fibre, steel or nylon.

The bolster means are preferably modular in design, so that individual bolster sides interlock with one another to form larger units.

The tooling system preferably further comprises vibrating means, so that the bolster sides can be vibrated to assist in bedding down the elements of the array.

The tooling system preferably further comprises sensors to detect and measure the forces applied

to the elements of the array and /or to detect any movement.

An embodiment of a tooling system according to the invention will now be described with reference to the accompanying drawings, in which

Figure 1 is a view of a machine layout;

Figure 2 is a plan view of an element array;

Figure 3 is a perspective view of the element array of Figure 2;

Figure 4 is a view of a bolster side;

Figure 5 is a view of a part of the bolster of Figure 4 and

Figures 5 (a); 5(b) and 5(c) are sections on the line V-V of the bolster part of Figure 5.

As can be seen from Figure 1, a tooling system shown generally at 10 comprises a support table 2 on which is located a bridge 4, comprising a horizontal span 6 supported by first and second vertical supports 8,12. The horizontal span 6 supports an adjustment mechanism 14 and a machining tool 16.

The system 10 further comprises a consumable module 20 comprising array elements 24 supported on cross rails 22, which are themselves supported on a chassis (not shown) on the support table 2.

Each of the elements 24 terminates in a threaded support post 25 which engages with an internally threaded aperture (not shown) in the cross rail 22.

First and second side arms 26, 28 extend from the first and second vertical supports 8, 12 respectively, and terminate in retractable pegs 30, 32 adapted to engage with recesses in the ends of the cross rails 22.

The elements 24 are arranged in an array, as shown in Figures 2 and 3 and are held in place by four bolsters 34, 36, 38 and 40. The elements 24 are orientated at -45° and +45°.

The machining tool shown generally at 16 comprises a spindle 42 and a tool head 44 mounted on the spindle 42.

The tool further comprises drive means (not shown) for locating and driving the tool head 44 via the spindle 42.

The adjusting mechanism shown generally at 14 comprises an adjustment fork 46 mounted on a hydraulic cylinder 48 and provided with a rotating drive (not shown).

The adjustment fork 46 comprises a square head portion 49 from which depend four tines 50, 52, 54 and 56, one tine depending from each of the four corners of the square head portion 49.

As can be seen from Figures 2, 3 and 4, the consumable module 20 comprises an array of elements 24 constrained by four bolster elements 34, 36, 38 and 40. Each of the bolster elements 34, 36, 38 and 40 comprises a back plate 62 on which are mounted an array of wedge shaped teeth 64 forming a serrated face.

As can be seen more clearly from Figure 4, a bolster element shown generally at 34 includes an array of teeth 64. Each of the teeth 64 comprises a housing 66 on each of two faces of which is mounted a contact plate 68.

As can be seen more clearly from Figures 5(a); 5(b) and 5(c), which are sections through the tooth 64 on the line V-V of Figure 5, showing different stages of the application of mechanical pressure,

each of the contact plates 68 is supported by three rollers 70, 72 and 74 which extend across the length of the housing 66. The rollers are supported in V-shaped grooves 76,78 and 80 formed in a support bar 82 which can be driven longitudinally along the length of the tooth 64. As the support bar 82 is driven along the tooth 64 in the direction of the arrows shown in Figures 5(b) and 5(c), the rollers 70, 72 and 74 rotate in the respective V-shaped grooves 76,78 and 80 and are displaced relative to the longitudinal axis of the support bar 82. As the rollers 70, 72 and 74 rotate in the grooves 76,78 and 80, the contact plate 68 is displaced and the pressure applied to the adjacent element is increased. As the support bar 82 is driven in the opposite direction, the applied pressure is reduced.

In use, the tooling system is assembled with the elements of the array in the closed and aligned position, using the bolster means to clamp the elements in the required positions. In order to clamp the array either before or after adjusting and machining the elements of the array as described in International Patent Application No. WO 02/064308, it is necessary first to ensure that the edges of the elements are all aligned; any misalignment can be corrected by applying localised pressure as required. When the desired surface contour has been obtained, the bolster elements 34, 36, 38 and 40 may be removed, preferably one at a time, after being replaced by simpler and relatively inexpensive and lighter weight bolster elements, for example bolster elements of a similar design but without teeth having the specific design features described in Figures 4 and 5.

Claims

1. A tooling system which comprises a plurality of elements arranged in an array, the elements of the array being movable between a closed position in which the elements contact one another and are secured in position, and an open position in which the elements of the array are spaced apart and are capable of vertical movement relative to one another, characterised in that the tooling system further comprises bolster means provided to hold the elements of the array securely in the closed position.

2. A tooling system according to claim 1 characterised in that the bolster means has an element contacting face which is adapted selectively to apply localised pressure to one or more elements of the array.

3. A tooling system according to claim 1 or claim 2 characterised in that the elements of the array are substantially polygonal in cross section.

4. A tooling system according to claim 3 characterised in that the elements of the array are substantially triangular, rectangular or pentagonal in cross-section.

5. A tooling system according to claim 3 or claim 4 characterised in that the elements of the array are arranged so that, in the closed position of the array, the major axes of adjacent elements are aligned and their vertices touch one another, so that the elements of the array tessellate.

6. A tooling system according to any of claims 1 to 5 characterised in that the array is substantially rectangular in plan view and bolster means are provided on at least two adjacent sides of the rectangular array.

7. A tooling system according to claim 6 characterised in that bolster means are provided on all four sides of the rectangular array.

8. A tooling system according to claim 7 characterised in that the outer edges of the rectangular array are serrated and the bolster means has a correspondingly serrated face.

9. A tooling system according to claim 8 characterised in that the face of the bolster means contacting the array is formed from a plurality of teeth, at least some of which teeth are adjustable in order to apply localised pressure selectively to one or more elements of the array, in line with the sides of the elements.

10. A tooling system according to claim 9 characterised in that the teeth are also individually adjustable in height relative to one another.

11. A tooling system according to any of claims 1 to 10 characterised in that the bolster means comprise two sets of bolsters, the first of which is used during machining of the elements of the tooling system and the second of which is used when the elements of the array have been machined and the system is being used as a mould.

12. A tooling system according to any of claims 1 to 10 characterised in that at least one of the bolster means is formed of two or more separate component sections, so that one or more component sections may be removed to allow opening and adjustment of a part of the array, while maintaining the remainder of the array secured in the closed position.

13. A tooling system according to any of claims 1 to 12 characterised in that the bolster means are modular in design, so that individual bolster sides interlock with one another to form larger units.

14. A tooling system according to any of claims 1 to 13 characterised in that it further comprises vibrating means, so that the bolster sides can be vibrated to assist in bedding down the elements of the array.

15. A tooling system according to any of claims 1 to 14 characterised in that it further comprises sensors to detect and measure the forces applied to the elements of the array and /or to detect any movement.

16. A tooling system according to any of claims 1 to 15 characterised in that it further comprises means for securing the bolster means in position around the array of elements.

17. A tooling system substantially as herein described and with reference to the accompanying drawings.

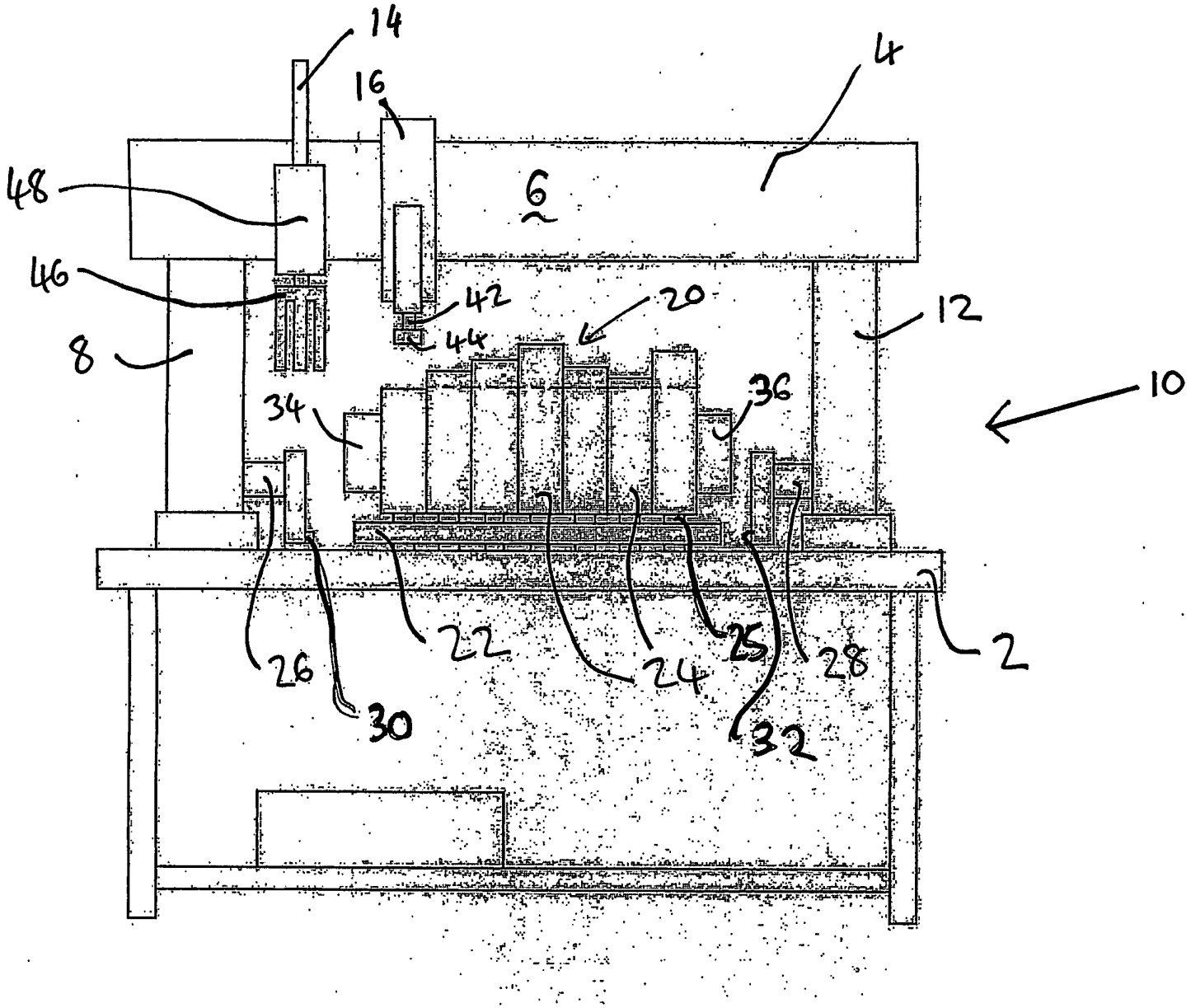

Figure 1

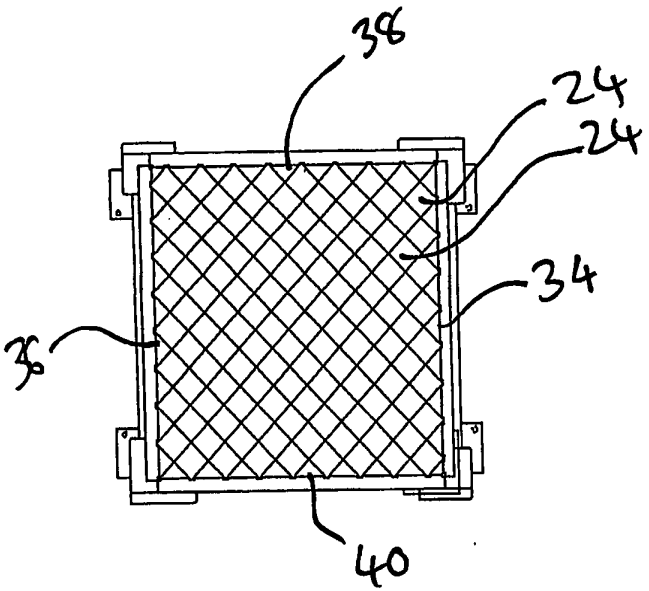

Figure 2

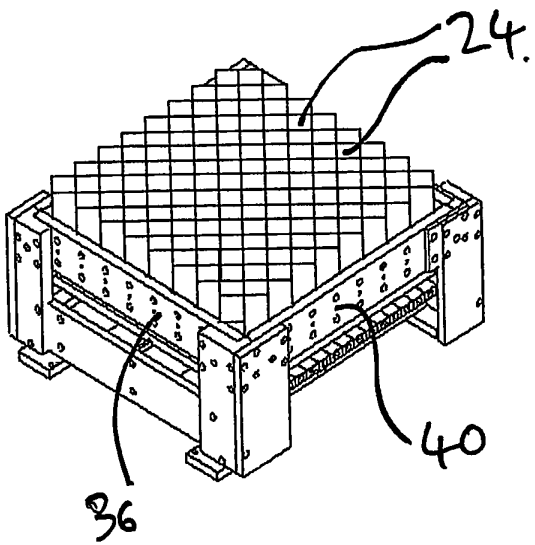

Figure 3

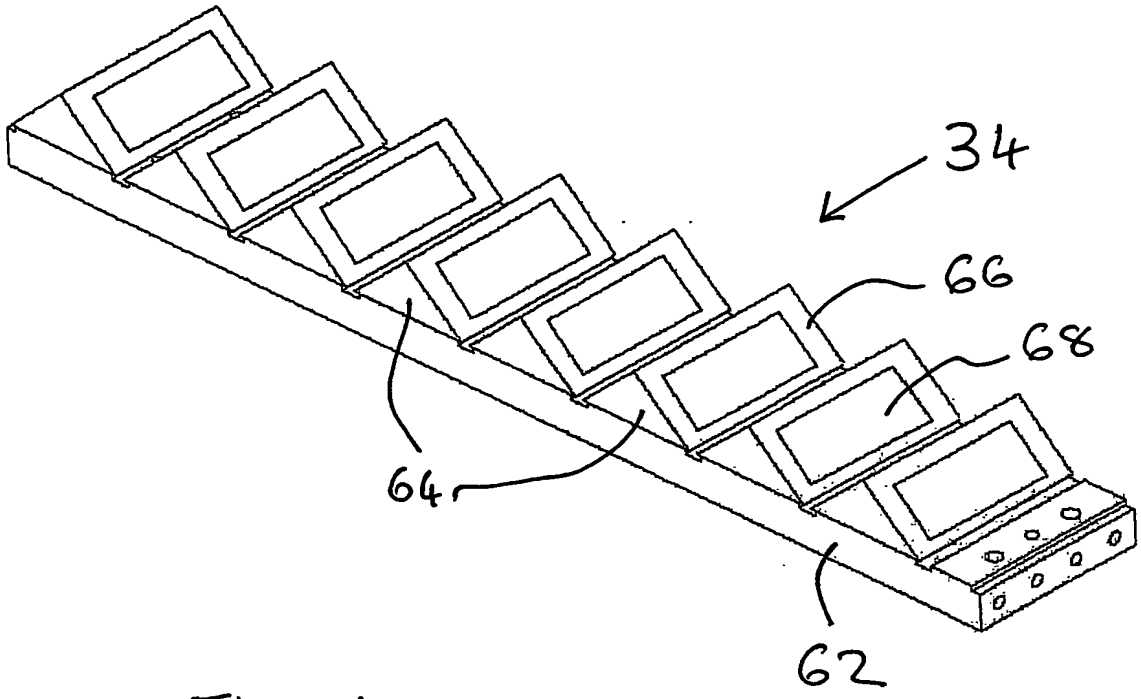

Figure 4

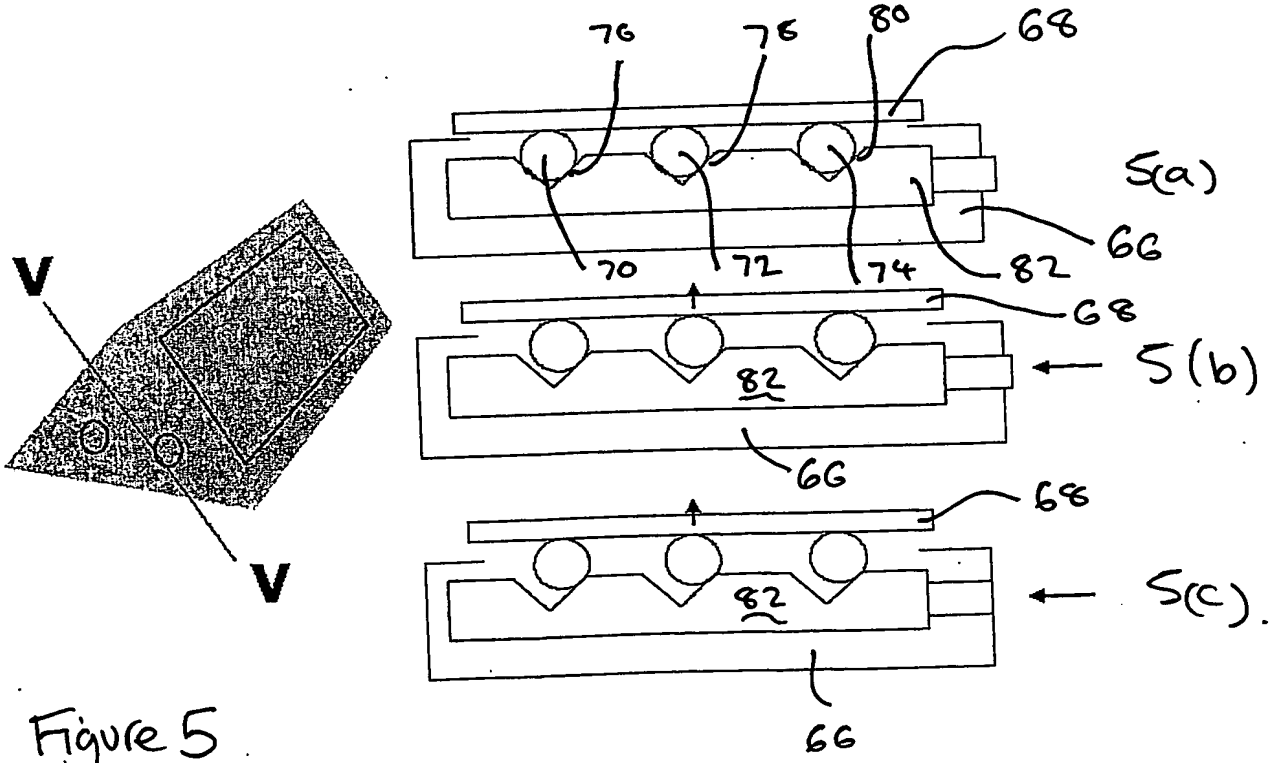

Figure 5

Document made available under the Patent Cooperation Treaty (PCT)

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